film are formed, in the same manner as in the previous case.

In any case, the thermal treatment for the antiferromagnetic layer may be effected after the formation of the spin valve film. When the thermal treatment is effected after the film formation, it is desirable that a magnetic field higher than the coupling magnetic field of the antiferromagnetically coupling layer 1442 is applied to the spin valve film being subjected to the thermal treatment so that the magnetizations of both the ferromagnetic layer A and the ferromagnetic layer B are saturated completely in the same direction (that is, in the height direction). For example, where the antiferromagnetic layer B/antiferromagnetic layer B is in the form of 2 nm CoFe/0.9 nm Ru/2 nm CoFe, the coupling magnetic field of Ru is about 6 kOe. Therefore, in this case, the magnetic field to be applied during the thermal treatment is preferably at least 7 kOe. In order to reduce the magnetic field for the thermal treatment, it is desirable to finish the thermal treatment before the spin valve film is worked into the form of a device. The thermal treatment of the device as worked from the film requires a stronger magnetic field for saturating the ferromagnetic layers A and B because of the reversal magnetic field intrinsic to the shape of the device.

In the method noted above, the magnetization of the pinned magnetic layer 144 is pinned in a predetermined direction. However, the heat treatment in the method is too

strong, the easy axis of the free layer 146 and even that of the lower shield 11 will also be pinned in the height direction of the spin valve device, like in the pinned magnetic layer. If so, it will be difficult to make the magnetization direction of the free layer perpendicular to that of the pinned magnetic layer. In order to fix the easy axis of the free layer and that of the lower shield in the direction of the track width, it is desirable to apply to the free layer and the shield, the minimum magnetic field necessary for saturating the shield and the free layer in the direction of the track width, for example, a magnetic field of from 100 to 300 Oe or so, in the resist curing step for fabricating recording heads, thereby stabilizing the easy axis of the shield and that of the free layer in the direction of the track width. Also preferably, the lower shield is previously subjected to thermal treatment before the completion of the spin valve film, thereby stabilizing its easy axis in the direction of the track width.

In the abutted junction type device of Fig. 17, in which the track edges of the free layer are removed and longitudinal bias layers are provided in place of the removed edges, the longitudinal bias layers may be of a hard magnetic film of, for example, CoPt, CoPtCr or the like as formed on a underlayer of, for example, Cr, FeCo or the like, or may be of a laminated, hard ferromagnetic film composed of a ferromagnetic layer 151 and an antiferromagnetic layer 152 as laminated in that order.

Alternatively, the antiferromagnetic layer 152 may be formed first, and thereafter the ferromagnetic layer 151 may be laminated thereover. In order to obtain a steep reproduction sensitivity profile capable of meeting the coming narrow tracks in the art, at the track edges, it is desirable that the magnetic thickness ratio of the ferromagnetic, longitudinal bias layer, or that is, the hard magnetic layer or the ferromagnetic bias layer as magnetically coupled by an antiferromagnetic layer, to the free layer, $(Ms \cdot t)_{LB}/(Ms \cdot t)_F$, is defined to be at most 2. Where the free layer is thinned to have a thickness of from 2 to 5 nanometers and have a magnetic thickness of from 3 to 6 nanometer Tesla, the ferromagnetic, longitudinal bias layers shall also be thinned in order that the ratio $(Ms \cdot t)_{LB}/(Ms \cdot t)_F$ is made to be at most 2. For example, the ferromagnetic, longitudinal bias layer shall have a magnetic thickness of at most 12 nanometer Tesla.

In general, however, when the hard magnetic film is thinned to have a thickness of 10 nanometers or so, then it could hardly maintain high coercive force. For example, for a hard magnetic film of CoPt having Ms of 1T, it has a high coercive force of 2000 Oe when its thickness is 20 nanometers, but its coercive force decreases to 800 Oe when its thickness is 10 nanometers. On the other hand, in the longitudinal bias layer of a type of ferromagnetic layer/antiferromagnetic layer, the magnetic coupling bias field increases with the reduction